This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

---

1. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-9 - 10i)(-3 - 2i)$$

The solution is $7 + 48i$, which is option B.

A. $a \in [44, 52]$ and $b \in [-13, -7]$

$47 - 12i$, which corresponds to adding a minus sign in the first term.

B. $a \in [5, 13]$ and $b \in [45, 52]$

* $7 + 48i$, which is the correct option.

C. $a \in [44, 52]$ and $b \in [9, 16]$

$47 + 12i$, which corresponds to adding a minus sign in the second term.

D. $a \in [5, 13]$ and $b \in [-48, -41]$

$7 - 48i$, which corresponds to adding a minus sign in both terms.

E. $a \in [27, 35]$ and $b \in [14, 25]$

$27 + 20i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

2. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{12}{0}}$$

The solution is Not a Real number, which is option C.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Irrational

These cannot be written as a fraction of Integers.

C. Not a Real number

* This is the correct option!

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{\frac{12}{0}}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

3. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-7 - 4i)(6 - 3i)$$

The solution is $-54 - 3i$, which is option E.

A. $a \in [-44, -41]$ and $b \in [7, 16]$

$-42 + 12i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

B. $a \in [-32, -28]$ and $b \in [42, 49]$

$-30 + 45i$, which corresponds to adding a minus sign in the first term.

C. $a \in [-57, -52]$ and $b \in [3, 5]$

$-54 + 3i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-32, -28]$ and $b \in [-47, -40]$

$-30 - 45i$, which corresponds to adding a minus sign in the second term.

E. $a \in [-57, -52]$ and $b \in [-7, -2]$

* $-54 - 3i$, which is the correct option.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

---

4. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{36 + 33i}{6 - 8i}$$

The solution is $-0.48 + 4.86i$, which is option D.

A. $a \in [4.4, 5.3]$ and $b \in [-1.5, 0.5]$

$4.80 - 0.90i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [-48.35, -47.25]$ and $b \in [4, 6.5]$

$-48.00 + 4.86i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

C. $a \in [-0.9, 0.45]$ and $b \in [485.5, 486.5]$

$-0.48 + 486.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-0.9, 0.45]$ and $b \in [4, 6.5]$

* $-0.48 + 4.86i$, which is the correct option.

E. $a \in [5.95, 6.45]$ and $b \in [-5, -3]$

$6.00 - 4.12i$, which corresponds to just dividing the first term by the first term and the second by the second.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

5. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-9 + 22i}{-3 + 4i}$$

The solution is $4.60 - 1.20i$, which is option A.

A. $a \in [3.5, 5]$ and $b \in [-2, -1]$

* $4.60 - 1.20i$, which is the correct option.

B. $a \in [3.5, 5]$ and $b \in [-30.5, -29]$

$4.60 - 30.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

C. $a \in [114.5, 115.5]$ and $b \in [-2, -1]$

$115.00 - 1.20i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

D. $a \in [2.5, 3.5]$ and $b \in [3.5, 6.5]$

$3.00 + 5.50i$, which corresponds to just dividing the first term by the first term and the second by the second.

E. $a \in [-3, -2]$ and $b \in [-5.5, -3.5]$

$-2.44 - 4.08i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

---

6. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{0}{49}} + \sqrt{4}i$$

The solution is Pure Imaginary, which is option A.

A. Pure Imaginary

* This is the correct option!

B. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

C. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

E. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

7. Simplify the expression below and choose the interval the simplification is contained within.

$$5 - 16^2 + 19 \div 4 * 11 \div 20$$

The solution is -248.387, which is option C.

A. $[262.9, 263.9]$

263.613, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

B. $[-255.4, -249.1]$

-250.978, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

C. $[-249.7, -247.8]$

* -248.387, this is the correct option

D. $[259.8, 261.5]$

261.022, which corresponds to two Order of Operations errors.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

---

8. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{1430}{10}}$$

The solution is Irrational, which is option C.

A. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

C. Irrational

* This is the correct option!

D. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

E. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{143}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

---

9. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{16}{16} + 81i^2$$

The solution is Rational, which is option A.

A. Rational

* This is the correct option!

B. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

C. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

D. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

E. Irrational

These cannot be written as a fraction of Integers. Remember: π is not an Integer!

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

---

10. Simplify the expression below and choose the interval the simplification is contained within.

$$2 - 10 \div 7 * 16 - (14 * 4)$$

The solution is -76.857, which is option B.

A. $[-57.09, -50.09]$

-54.089, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[-78.86, -75.86]$

* -76.857, which is the correct option.

C. $[49.91, 63.91]$

57.911, which corresponds to not distributing addition and subtraction correctly.

D. $[-139.43, -138.43]$

-139.429, which corresponds to not distributing a negative correctly.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.
